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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/867,467	05/31/2001	Hiroyuki Nagasawa	209291US0	6872

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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 12/17/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/867,467	NAGASAWA ET AL.	
	Examiner	Art Unit	
	Matthew J Song	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 02 October 2003.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 9-11 and 13-26 is/are pending in the application.

4a) Of the above claim(s) 9-11 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 13-26 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 8/27/2003 has been entered.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 13 and 19 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 13 recites, " a method of manufacturing a **dopant-free** single crystal" in line 1, likewise for claim 19. A **dopant-free** single crystal is not supported in the instant specification. The instant specification is merely silent to any doping. The mere absence of a positive recitation is not basis for an exclusion (MPEP 2173.05 (i)).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 13-15, 19-21, and 25-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Larkin et al (US 5,709,745).

Larkin et al discloses a method of forming a single crystal of Silicon Carbide (SiC) on a SiC substrate at a temperature of 1450°C using silane and propane source gases or other source gases may be used (col 22, ln 25-40, col 11, ln 35-50 and Claim 1). Larkin et al also discloses the growing of a SiC film is very sensitive to the ratio of silicon compound and carbon compound in the reaction chamber during crystal growth and by varying the ratio between 0.01 and 1, the growth rate can be controlled (col 11, ln 5-35 and col 14, ln 1-20). Larkin et al also discloses the purity of a crystal grown by a CVD process can be controlled by the manipulation of site

competition at particular growth site of the SiC film and by adjusting crystal growing compound concentration ratio within the reaction chamber to reduce the demand of the contaminant at the growth site (col 18, ln 39 to col 19, ln 10).

Larkin et al discloses varying concentrations of source gases to control the contaminant incorporation into a growing crystal film by changing the concentration of source gases added (col 18, ln 39 to col 19, ln 10). Larkin et al does not disclose varying partial pressures of source gases. However, the varying of partial pressure of source gases is a well known in the art as a method of controlling the concentration of elements in a vapor deposition apparatus, note Kisielowski et al (US 6,139,629) and Karapiperis et al (US 5,294,564) below, therefore controlling partial pressures is an equivalent method of controlling concentration to Larkin's method. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin et al by changing the partial pressure of source gases to control the concentration of source gases in a deposition chamber because substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06).

Larkin et al teaches controlling purity in SiC by selecting a ratio of a first crystal element to a second crystal element and changing the ratio to during growth (col 18, ln 39 to col 19, ln 10 and Claim 1). Larkin is silent to a pc2/ps ratio of less than one times the attachment coefficient. However, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin et al by optimizing the partial pressure by conducting routine experimentation of a result effective variable (MPEP 2144.05). Furthermore, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or

workable ranges by routine experimentation. (In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235(CCPA 1955)).

Larkin et al is silent to the partial pressure ratio pc1/ps falls within the range of 1-10 times the attachment coefficient, however Larkin et al discloses the Si to C ratio is between 0.01 and 1 (col 14, ln 1-10). Applicant discloses an embodiment in the instant application, where SiH_2Cl_2 is supplied at 10 sccm and C_2H_2 is supplied intermittently at 10 sccm [0028], which based on Larkin's teachings of concentration would be a ratio of Si/C ratio of 1:2 or 0.5 because C_2H_2 contains 2 carbon atoms. Therefore, a partial pressure ratio pc1/ps falls within the range of 1-10 times the attachment coefficient is inherent to Larkin et al because Larkin et al discloses a similar range of concentration, as applicant, for single crystal growth.

Referring to claims 14 and 20, Larkin et al teaches Silane (SH_4) and propane (C_3H_8), note column 9, lines 25-40.

Referring to claims 15 and 21, Larkin et al teaches introducing vaporized compounds in a reaction chamber and maintaining proper material flow rates in the reaction chamber for a sufficient time to grow a crystal film having a desired smooth surface morphology, uniform thickness, and a controlled impurity profile (col 11, ln 15-30), this is a teaching that time of material flow is a result effective variable. Larkin et al does not teach the timing of 0.1-30 seconds. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin et al by optimizing same by conducting routine experimentation of a result effective variable. The selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)).

Referring to claim 19, Larkin et al teaches a method of changing a ratio of silicon and carbon by using a constant silane flow and varying propane between 400-000 ppm (Example 11). Larkin et al does not teach maintaining a constant carbon source gas flow and varying the silicon source gas flow. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin et al by having a constant carbon flow and a varying silicon flow, which is equivalent to varying the carbon flow and maintaining the silicon flow for adjusting the Si/C ratio. Substitution of known equivalents for the same purpose is held to be obvious. (MPEP 2144.06)

6. Claims 16-17 and 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Larkin et al (US 5,709,745) as applied to claims 13-15 and 19-21above, and further in view of Sugiyama et al (US 5.964.944).

Larkin et al teaches all of the limitations of claim 16, as discussed previously, except the silicon carbide is employed as a seed crystal and silicon carbide is formed on the seed crystal by vapor phase epitaxy, sublimation recrystallization or liquid deposition.

In a method of producing silicon carbide single crystals by vapor phase epitaxy, note entire reference, Sugiyama et al teaches using large silicon carbide seed crystals, as large as 3-4 inches in diameter, in the production of a large size silicon carbide single crystal (col 5, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin et al with Sugiyama et al to produce larger silicon carbide crystals useful in the semiconductor industry at a low cost (col 1-67; col 2, ln 1-67). In regards to applicant's bore of 4-6 inches, overlapping ranges are held to be obvious (MPEP 2144.05).

7. Claims 18 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Larkin et al (US 5,709,745) as applied to claims 13-15 and 19-21 above, and further in view of Gardner (US 3,630,678).

Larkin et al teaches all of the limitations of claim 18, as discussed previously, except the silicon carbide is employed as a seed crystal and diamond and/or gallium nitride is formed on the seed crystal.

In a process for growing diamond, note entire reference, Gardner teaches a diamond grown on a silicon carbide seed with improved crystallinity grown using carbon containing gases (col 7, ln 1-67; col 1, ln 1-67; Claim 1). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin et al with Gardner to produce diamonds, which are useful as abrasives and semiconductors (col 1, ln 1-25).

Response to Arguments

8. Applicant's arguments filed 8/27/2003 have been fully considered but they are not persuasive.

Applicant's argument that Larkin et al does not teach a method of forming a dopant-free SiC is noted but is not found persuasive. Larkin et al does teach forming doped SiC, as alleged by Applicant; however Larkin's method of varying the ratio of crystal growing components is not limited to forming doped SiC. Larkin et al teaches controlling the amount of a contaminant in a crystal (col 33, ln 60-65 and col 18, ln 39 to col 19, ln 10) to control purity of the growing

crystal. Therefore, Larkin's teaches using varying concentration to prevent contamination and control purity by preventing contamination.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Karapiperis et al (US 5,294,564) teaches a reduction of an n-type dopant of Si, namely the partial pressure of SiH_4 in the gas phase in a vapor deposition (col 13, ln 10-60).

Kisielowski et al (US 6,139,629) teaches the concentration of Bi, Ga and Mg is determined by controlling the temperature of the evaporation source, which in turn determines the partial pressure of the element in a MBE chamber (col 4, ln 30-65).

Lerner (US 5,167,935) teaches the partial pressure of a component is directly proportional to its ppmv gas concentration (col 11, ln 30-45).

Dobson (US 4,666,565) teaches the concentration (partial pressure) of a reacting gas in a gas sample (col 4, ln 45-67).

Venkatesan et al (US 5,863,598) teaches gas flow rates may be used instead of partial pressures sine the partial pressure of a gas is related to its flow rate (col 8, ln 10-40).

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 703-305-2667. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS

SUPERVISOR
NADINE G. NORTON
PRIMARY EXAMINER